ORIGINAL ARTICLES

EXPERIENCE WITH ARTIFICIAL PNEUMOTHORAX IN THE TREATMENT OF PULMONARY TUBERCULOSIS.*

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PART I. TECHNIC.

Dr. F. Fehleisen.

It is now over three years since we began to treat selected cases of lung tuberculosis with induced pneumothorax, and 45 patients have been inflated so far in Dr. Rothschild's sanatorium. I would like to make some remarks in regard to the technic.

At the time of our first experiments it was impossible to procure nitrogen-bombs in this city, as they are used in the East and in Europe. We had a simple apparatus made here, as described and illustrated by Brauer and Spengler,* and we have been using it ever since, both for the preparation of the nitrogen and for the inflation. It is the same apparatus originally devised by Murphy, with the addition of a cotton filter for the gas and an air-manometer. This inexpensive and easily extemporized apparatus has given so much satisfaction that I describe it for the benefit of those who have none of the modern and more expensive imported apparatus at their disposal.

* Klinik der Tuberkulose, Vol. xiv, p. 425.

A and B. are graduated glass bottles, connected at the bottom by a rubber tube. C is a cotton filter, D a water-manometer and E stopcocks or clamps. Our bottles contain 4000 cc. To prepare the nitrogen we first pour 1000 cc. of a 20% pyrogallic acid solution in bottle B and then 40-50 cc. 20% potassium hydroxyde solution. The openings at the top of bottle B are now closed but the rubber tube connecting A and B is left open and some pyrogallic acid solution is poured into bottle A. In 24 hours bottle B contains sufficiently pure nitrogen. By filling up bottle A and elevating it we can produce any desired amount of pressure for the nitrogen. The whole apparatus can easily be taken apart and sterilized.

In our first 20 cases we followed the advice of Murphy and Brauer, to expose the pleura for the first inflation by a small incision under local anesthesia and to perforate the pleura with a blunt Salomon needle. This gave good results. Our incisions healed under a small dressing with adhesive plaster by p. i. and the patients did not have the slightest inconvenience after the operation. Later on we used a sharp needle without incision, not because we had any bad results from the incision, but simply because we found it unnecessary in the majority of cases.

The object of the incision, as still advocated by Brauer and his school, is to eliminate the possibility of injuring the lung and the danger of air embolism.

The combined experience of Forlanini and many other well-known men prove conclusively that a properly constructed sharp needle does not injure the lung, when it enters the free pleural cavity. In the presence of adhesions it may, of course, enter into the lung tissue, but then it does no harm. The experienced operator feels distinctly the resistance of the costal pleura and the needle will not be pushed beyond it more than a few millimeters. This causes no hemorrhage, and infection of the pleura from the lung is impossible when the lung is adherent to the costal pleura. The needle is taken out, in this case, and reinserted in another place where we hope to find no adhesions, and it is a great advantage that we can search the surface of the lung systematically for a suitable place for the inflation without much loss of time when we use a sharp needle without incision.

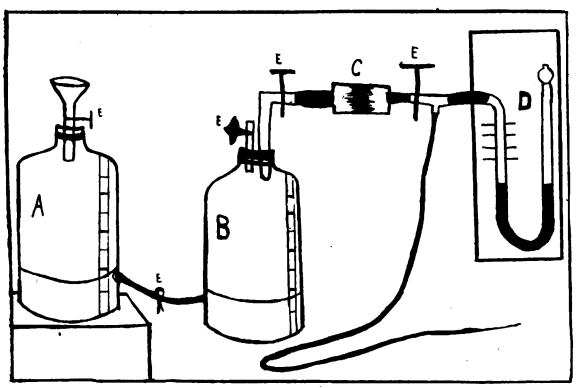
The danger of air embolism should not be underestimated. Several fatal cases have been reported. Most of them were caused by faulty technic or when high pressure was used to break up dense adhesions. There is only one way to exclude every possibility of air embolism: the gas must not be allowed to flow through the needle until we are sure from the readings on the manometer that the needle is in the free pleural cavity. If this is the case, the manometer shows constant negative pressure and the characteristic respiratory oscillations. The negative pressure during deep inspiration may be 8-10 cent. water; if a considerable part of the pleural cavity is obliterated by adhesions it is lower. But always we have constant negative pressure and respiratory oscillations of several cent. water in the pleural cavity. This is not the case if the needle has punctured the lung or when it is extrapleural between costal pleura and endothoracic fascia. In the latter case we have usually slight + — oscillations of the manometer. Should the needle have entered a bronchus, then, of course, we have + pressure during expiration, and same would be the case if the needle should be in the lumen of a vein.

As soon as the correct position of the needle is ascertained, the connection with the gas tank is opened and gas is allowed to flow in under low pressure. It is advisable to stop the inflow for a while after 100-200 cc. are injected. If the patient shows no discomfort, 1000 cc. and more can be given at the first inflation. In many cases we must be content to inject a few hundred cc. on the first day or even less. It is better not to use very high pressure at the first inflation. Later on as much as 25 or 30 c. water pressure can be used in some cases with advantage to loosen adhesions.

I have been asked several times by colleagues what to do when no free pleural cavity can be found after repeated punctures. Even such cases are not hopeless, but the operation is more difficult and sometimes not entirely without danger. The manometer does not show when the needle passes the pleura; you have to rely on your sense of touch. If doubtful, I would make an incision in such exceptional cases. Here Brauer's method may be of advantage even to the experienced operator. As soon as one is convinced that the position of the needle is correct, gas is injected in small quantities, few cc. at a time. Forlanini com-

* Read before the Forty-third Annual Meeting of the Medical Society, State of California, Oakland, April, 1913.

presses the rubber tube near the needle with the fingers, thus forcing in a little gas; others use a syringe filled with nitrogen or oxygen to break the adhesions, but not more than 3 or 4 cc. should be injected at a time. Such small quantities, if injected slowly, would not cause death, even if injected into a vein. After each injection the patient must be watched carefully for a minute or two. If he shows difficulty in breathing, if the pulse becomes frequent, irregular or weak, if the patient



complains of pains or a feeling of oppression or shows other symptoms of embolism or shock from pleural reflexes, then the position of the needle has to be changed or better the operation is postponed.

Holmgren injects in such cases 50-100 cc. normal salt solution before injecting gas. If the salt solution is injected too deep—into the lung tissue—then it causes coughing and sometimes expectoration with salty taste. Fortunately such cases are exceptional. Forlanini has repeatedly stated that the classical cases for gas-compression are those where at least a small part of the pleural cavity is still free from adhesions. Here the inflation, under proper precautions, is almost entirely free from danger and undoubtedly of great value.

Dr. Rothschild's report will show you the favorable results obtained in his clinic, from which I believe we can recommend this method for more general use.

PART II.

Effects of and Indications for Artificial Pneumothorax in the Treatment of Pulmonary Tuberculosis.

Dr. Max Rothschild.

The great and general interest which has been aroused in the treatment of pulmonary tuberculosis by artificial pneumothorax warrants a short review of the indications for this treatment, and the discussion of some of its interesting points.

At the State Medical Meeting in Santa Barbara in 1910, and also at the meeting of the American Medical Association in Los Angeles in 1911, I had the honor to present a paper on this subject. At that time the treatment was discussed only in regard to its efficiency in cases of severe hemoptysis, but I had already treated a number of cases which had acute septic tubercular process of one side without hemoptysis, by this same method. The first patients were treated by Dr. Fehleisen and myself about three and a half years ago. Some were cases of hemoptysis and some were cases of one-sided tuberculosis with cavity formation. Since that time forty-four patients have been treated by lung compression and the results have been most satisfactory. In three cases it has been impossible to get into the pleural cavity on account of severe adhesions, and in spite of the fact that otherwise they seemed to be classical cases for Forlanini's method, the operation had to be given up. One case of severe hemorrhage died of miliary tuberculosis about six weeks after the first inflation. Four cases discontinued the treatment before they were advised to do so. In three cases the other side showed signs of progressive tuberculous processes, and treatment had to be stopped on that account. In the other thirty-three cases the results were good. I feel sure these thirty-three cases would have died if the artificial pneumothorax had not been applied.

Before discussing the indications for pneumothorax it might be well to say a few words in regard to the method itself and the logic of its application. One of the most important factors in the treatment of any diseased organ is rest, and recognizing this, we know that tuberculous patients will do a great deal better when kept quietly in bed than if allowed to walk about. Some authorities have tried to enforce this principle by strapping the diseased side, but since the introduction of artificial pneumothorax by Forlanini, it has been possible to compress the diseased lung to such an extent that the breathing is practically stopped.

As Dr. Fehleisen has stated, the operation is a very simple one; the only real difficulty in some cases consists in finding the proper site for the first introduction of the gas. Many cases of tuberculosis of the lungs are complicated by pleuritic adhesions, and a satisfactory compression is only possible when the lung is free. But if these conditions are favorable and the proper place for the first operation is chosen, the method is easily applied and a very complete compression of the diseased lung can be obtained.

Now, as to indications and effects of complete lung compression. First: As mentioned before, it puts the diseased lung entirely out of commission and gives the organ as perfect a rest as is possible. Second: In the majority of cases, it prevents through compression of the lymphatic ducts, an absorption of toxins, and consequently we get in practically all fever cases, a normal temperature one or two days after the compression of the diseased lung. Third: In hemoptysis it compresses the bleeding blood vessel and thus stops the hemorrhage very promptly. Fourth: In cavity formation it brings the walls of the cavities—if they are not too large—together and makes a status curandi possible, which otherwise, through the slow process of granulation, would take many a week or month to achieve; and again, as a result of the compression of this cavity formation, almost immediately after the operation cough and amount of sputum decrease very considerably.

These four features, rest of the diseased lung,